forty-six families were described and the principal genera enumerated. His paper also contained a tolerably complete bibliography of the subject, the size of which is shown by the fact that it embraced the titles of fourteen hundred and forty-six papers. The systematic position of the sponges was also discussed.

EMBRYOLOGY.[1]

Haddon's Introduction to the Study of Embryology.[2]—This new work, now in press, is apparently designed to give the student a comprehensive outline of the science of embryology in a moderate compass, with such illustrations as will enable him to appreciate the fundamental similarity of many of the stages of the embryos of the different classes and orders of the Metazoa as represented by specific forms. A manual of this sort has been very much needed for the class-room. The monumental treatise of Balfour, in two volumes, already needs revision, so fruitful have been the labors of active embryological workers within the last five years, or since its completion. That activity itself has been very largely due to the stimulus given to ontogenetic research by that singularly endowed genius, lost to us before he had had time to develop the germs of the great generalizations and suggestions which are so lavishly strewn through the pages of his great work. Balfour's large work, also, is not adapted to the purpose of a class-room manual, and can only be used as a book of reference or as a guide to the advanced student. In the first volume, and the early part of the second, the groups are treated of separately and not directly and comparatively, so that it is not well adapted to serve as a text-book for the laboratory in elementary work. Other elementary text-books use only extremely modified forms, such as the chick and the mammal, as types; other lower groups being scarcely alluded to. This tends to develop a bias in the mind of the student which it is hard for him to shake off, and in extending the range of his studies he finds himself almost unwittingly trying to attempt to apply his knowledge of the development of the higher forms to that of the lower, with the result that he becomes confused in making his comparisons. To overcome this difficulty we need an elementary work which will contrast the higher and lower types at once, and in such a way as will lead the student to at once see the agreements and differences in the methods of development of different types. It is especially important to show what a profound influence the presence of a larger and larger amount of yelk has had in modifying gastrulation; how the types of cleavage have been apparently modified from the same cause,

[1] Edited by Dr. JOHN A. RYDER, Philadelphia.

[2] An Introduction to the Study of Embryology, by Alfred C. Haddon, M.A., Professor in the Royal College of Science, Dublin. London, 1887.

and so on. These and kindred questions will evidently be fairly dealt with in Professor Haddon's treatise, judging from the advanced sheets of the first forty pages of the work, which the editor of this department has had the opportunity of examining. The work will evidently be up to date, and many points upon which the earlier authors were uncertain will be cleared up. The newer views as to the origin of the middle germinal layer will be presented, and Duval's discoveries in the development of the chick will receive the attention they deserve. The more recent discoveries in mammalian embryology and the discussion of karyokinesis, so far as it relates to embryology, will also find a place. On the whole, it may be said that this work is a timely one, which will be welcomed by all who are alive to the significance of the great issues of the embryological science of the future. The author and publisher are also to be congratulated upon the many new figures introduced,—many of them original,—and the excellent typographical appearance of the pages. The style of the author is clear and terse, a matter that is not always as well attended to by the authors of elementary text-books as is desirable, in spite of the remarkable precedents before them in the clearly-written elementary manuals by such writers as Huxley, Clifford, and Tyndall.

Development of Mysis.—Nusbaum gives (*Biol. Centralblatt*, vi. 663) a preliminary account of his observations on the development of Mysis. According to him the egg is surrounded by a blastema, and has the nucleus lying at the formative pole. The result of the first segmentation is to form two cells, one of which forms the blastoderm while the other sinks into the yelk. The larger central cells of the blastoderm later divide and give rise to cells which sink beneath the blastoderm, and together with the product of the first segmentation just mentioned are called "Vitellophags." After this process the rudiments of the embryo appear,—a caudal area from which extend forward the ventral bands, which diverge like a V and terminate in the oval cephalic lobes. Now, according to Nusbaum, a shallow invagination takes place in the caudal area, and the invaginated cells undergoing a rapid proliferation form a solid entoderm. Behind this point the abdomen now grows out. The mesoderm, says Nusbaum, arises as two bands from the ventral bands. The vitellophags at first lie just beneath the germinal area, but later they sink deeper into the yelk, and as their name implies they feed upon the yelk. Nusbaum has some comparisons with the development of various hexapods, which he thinks are similar in the formation of the germinal layers, and his vitellophags he compares to similar cells in Scorpio and Oniscus, as well as to the phagocytes of Metschnikoff. He also describes a dorsal organ which appears at first as a paired ectodermal thickening, the

halves of which eventually unite on the dorsal median line. Of its function or meaning he expresses no opinion, but thinks it is the same as the dorsal organ well known in Tetradecapods.

While we must wait for the publication of the final paper—promised in the *Archives de Zool. Experimentale*—before expressing definite conclusions as to the accuracy of Mr. Nusbaum's interpretations, it would appear as though he had fallen into several errors. First, his vitellophags are apparently ento-mesoderm, and their formation is the gastrulation. Second, the gastrulation described by Nusbaum can be reconciled with the formation of the ventral flexure, and his mesoderm, as shown by his figure, is clearly the early stage of the nervous system. Looked upon in this way, Nusbaum's account is reconcilable with what is known of the development of other Crustacea; in any other way it is unintelligible. Nusbaum, it may be said in passing, is not the first one who has mistaken the ventral flexure for an invagination. —*J. S. K.*

Development of Spiders.—Morin gives (*Biol. Centralblatt*, vi. 658) an account of the development of Theridion, together with notes on that of Pholcus, Drassus, and Lycosa. The nucleus lies at the centre of the egg, and not until the third segmentation (eight cells) does the yelk segment. From this point the segmentation of the yelk pyramids accompanies that of the nucleus, through the stages of 16, 32, 64, etc., until the 128-cell stage is reached. Morin saw no polynuclear pyramids. At the 128-cell stage the nuclei and the surrounding protoplasm have reached the surface and form the blastoderm. They then separate from the pyramids, and the yelk then forms a homogeneous unnucleated mass. The blastoderm now becomes thicker on the ventral surface, and from its centre cells are budded inwards, some of which remain between the parent cells and the yelk, while others sink into the yelk itself. The germ now consists of all three layers. Morin does not regard the primitive cumulus as of such importance in the formation of the germ layers. In his experience it does not appear until after they are formed; indeed, he could not find it in any stage in Theridion. In Pholcus it was formed chiefly of mesoderm-cells, the ultimate fate of which was to form blood-corpuscles. In other points of the early development he agrees well with Locy (see this journal, xx. p. 676). The germinal area now becomes divided into segments, and then the appendages appear, first the four pairs of walking-legs, next the maxillæ, and then the mandibles; the abdomen has but four pairs of rudimentary appendages. At the same time the appendages appear the body cavity begins to form. The heart is formed much as in annelids, and as described by Kowalevsky and Schulgin in the scorpion. Its cavity is a remnant of the segmentation cavity. Now the splanchnopleure

becomes thrown into a series of folds (Balfour's septæ) in the abdominal region, dividing the yelk into a series of lobes, the rudiments of the liver.[1] The proctodæum and stomodæum offer nothing for note. The mesenteron does not begin to take definite shape until a day or two before hatching. Then the entoderm-cells which are scattered through the yelk gather at the inner ends of the fore and hind guts, and later unite in the middle. A similar process gives rise to the liver epithelium. This process is not completed at hatching, and for some time the young spider takes no food, the yelk remaining serving for food. The lungs arise as ectodermal invaginations at the base of the first pair of abdominal appendages, these becoming converted into their outer covering. The second pair of abdominal appendages disappear, the third and fourth are converted into the spinnerets, the spinning glands arising as ectodermal invaginations into their walls. —*J. S. K.*

PSYCHOLOGY.

The Seat of Consciousness.—M. Steiner, of Heidelberg, presented to the Academy of Science of Berlin, on January 7, 1887, a memoir on the consciousness of the cerebral hemispheres in fishes. The author, who has published a similar paper on the Batrachia, comes to the following conclusions:

1. In the fishes voluntary movements and the ability to feed spontaneously (proving the existence of both reflex and direct sensations) *persist* after the removal of the hemispheres.

2. In Batrachia these functions are bound to the hemispheres, excepting vision, which remains after their removal.

3. In birds vision is also located in the hemispheres, but not cutaneous sensation.

4. In the Mammalia, finally, the cutaneous sensations also are located in the hemispheres.

The author therefore concludes that in the Vertebrata the functions of the middle brain emigrate little by little into the hemispheres as they develop; or, rather, that the evolution of hemispheres depends on a successive accumulation of functions which at first belong to the middle brain.—*A. Herzen in Revue Scientifique*, No. 9, 1887.

Remarkable Intelligence of a Rat.—As throwing light upon the question of the intelligence of the animal creation, in the exhibition of memory and reasoning power, beyond the mere pale of recognized instinct, I wish to give the readers of the AMERICAN NATURALIST a brief account of an interesting incident of which I was witness. On a very warm day in early summer I happened to be standing near a chicken-coop in a back yard when I noticed the head of a very gray and grizzled rat thrust

[1] Compare Limulus.—*Ed. Nat.*